

Eco-Friendly Building Materials

Case Study of Pune

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Aim of the study



To understand the building materials market in Pune and recommend alternative eco-friendly materials for use.

Objectives

- ◆ **Task 1** -Develop a comprehensive list of conventional building materials
- ◆ **Task 2** -Evaluate existing building product eco-rating/assessment systems for adopting to the Indian context.
- ◆ **Task 3** - Recommendations for a rating system for evaluating eco-friendly building product
- ◆ **Task 4** - Recommend a list of eco-friendly materials suitable for Pune.

Methodology

- ◆ Internet Data Search
- ◆ Market Survey
- ◆ Communication with Retail Vendors and Manufacturers
- ◆ Data Collection from Local Builders, Contractors and Architects
- ◆ Inputs from Local Public Works Department
- ◆ Review of research by HUDCO, BMTPC, TIFAC, CBRI etc.

Task 1 – List of Materials

Types of information collected

- ◆ Material
- ◆ Unit of measurement of each material
- ◆ Cost per unit
- ◆ Method of sale – Over the counter or by order
- ◆ Locally available or not locally available
- ◆ BIS code/ international codes

List of Materials

CATEGORY	BASE MATERIAL	NAME OF MATERIALS	UNIT	INDICATIVE COST/UNIT		VENDORS	AVAILABILITY	MANUFACTURER DETAILS	IS CODE	ASTM CODE	OTHER CODES	REMARKS
				LOW	HIGH							
						refer to vendor list	OTC - over the counter; BO - by order	NML- Not manufactured locally				
Civil Materials	Cement	Cement 43 Grade	Bag of 50Kg	150		73, 2, 4	OTC	NML	8112:1989	C150		
Civil Materials	Cement	Portland Pozzolana Cement Flyash Based	Bag of 50Kg	148		73	OTC	NML	1489:1991	C618	BS 3892	
Civil Materials	Concrete	Ready Mix Cement Concrete M7.5 - M60 (6CUMT. = 1 Truck)	CUMT	2200	2600	25, 81	BO	1,2	456:2000	C94		
Civil Materials	MS	M.S sheets	KG	42	45	9, 26	OTC	NML	2062:1999, 2385:1977, 412:1975			
Civil Materials	MS	Tor Steel Re-bar 8mm	M.T.	31500		14, 27	BO	14	432:1982, 2062:1999	A184/A1 84M		
Civil Materials	Bitumen	Rubber Modified Bitumen (Bulk) CR-50	M.T.	17601		6, 33	OTC	NML, brought in tankers from mumbai	15462:2004	A184/A1 84M		
Civil Materials	Sand	Sand	BRASS	1900	2100	2, 8	BO	5,8	1542:1992, 2116:1980	A184/A1 84M		
Civil Materials	Brick	Bricks 1st Class 9x6x4	1000 NOS.	3400		2, 3	BO	5	1077:1992	A184/A1 84M		
Civil Materials	Fly-ash	Fly-ash Bricks 220X105X80mm	NOS	3.75		62, 82	BO	4	13757:1993, 3812:1981	A184/A1 84M		
Paving, Flooring, Tiles and Similar finishes	Fly-ash	Fly-ash Interlocking Paving Blocks(50-60mm) M20 grade	SQFT	25		62, 82	BO	4	3812:1981, 10360:1982	A184/A1 84M		

Categorisation Of Materials

Categorized based on Activity and Vendor Specific

1. Civil materials
2. Water-proofing and Chemical additives
3. Paving, flooring, dado and similar finishes
4. Paints, colors, white washing, distempering and wood finishes
5. Wood work
6. Roofing and ceiling
7. Doors and windows
8. Water supply and sanitary fittings
9. Electrical works
10. Fire fighting system
11. Miscellaneous
12. Excavation work
13. Road works

Constraints

1. Cost of materials

- a. Material cost varying over a range covering quotes from various manufacturers and market brands.
- b. The builders usually gets a negotiated price for the material which is much lower than the market cost.

2. Transportation

Many products have company distribution center in the city, thus although it may not be produced locally it does not affect the cost.

Task 2 -Evaluating Eco-friendly Materials



Why eco-friendly materials?

- ◆ Phenomenal growth in the construction industry that depends upon depletable resources.
- ◆ Production of building materials leads to irreversible environmental impacts.
- ◆ Using eco-friendly materials is the best way to build a eco-friendly building.



What is Eco-friendly material ?

- ◆ **Dictionary:** describes a product that has been designed to do the least possible damage to the environment
- ◆ **US EPA – EPP program defines as:**
"...products or services that have a lesser or reduced effect on human health and the environment when compared with competing products or services that serve the same purpose..."

Eco-friendly

Eco-friendly

Material

Bamboo

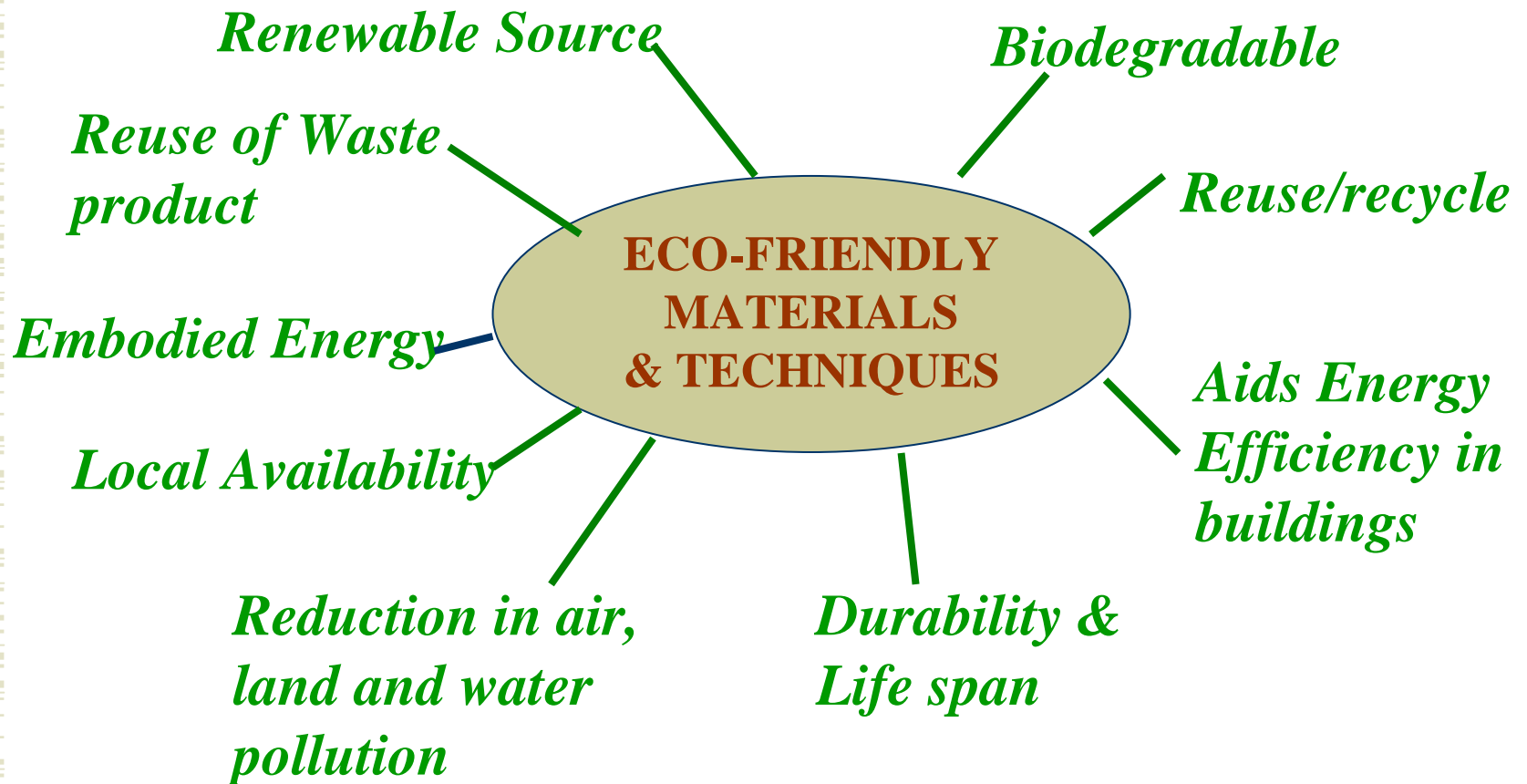


Technique

Rat Trap Bond



Properties



Source of Material

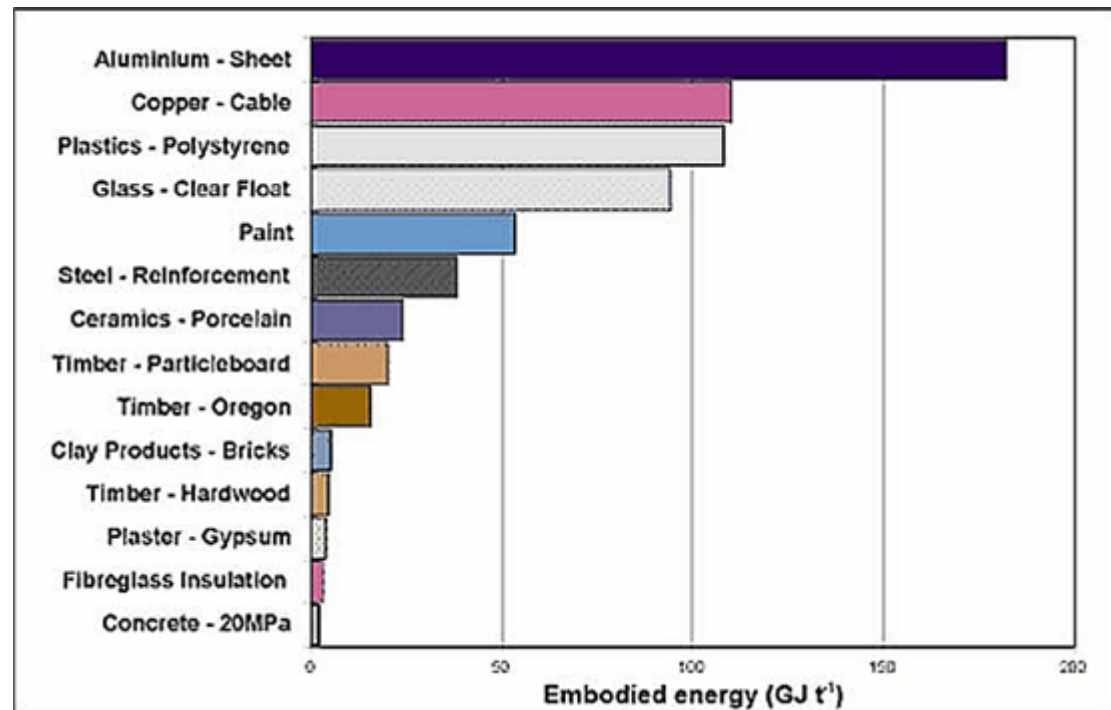
- a. Renewable source –
Rapidly renewable
sources e.g. *wood from
certified forests*



- b. Reuse of Waste
- ◆ Salvaged products –e.g. *old plumbing, door frames*
 - ◆ Recycled contents –
agriculture/ industrial
waste e.g. *Bagasse Board*

Embodied Energy

Scalar total of energy input required to produce the product including transporting them to the building site



Local Availability

Transportation Cost – For materials not available locally the transportation cost can form a significant part of its embodied energy.

S.No	NAME OF MATERIALS	TRANSPORTATION DISTANCE (approx.) unit - km	TRANSPORTATION COST COMPONENT unit - %	TRANSPORTATION ENERGY kwhr/kg	EMBODIED ENERGY kwhr/kg	TRANSPORTATION ENERGY COMPONENT unit - %
1	Ordinary Portland Cement / Blended Cement	200	27.98	0.2670	2.2000	10.82
2	Ready Mix Cement Concrete M30	10	17.09	0.0160	0.4445	3.47
3	Gypsum Plaster	500	26.96	0.5180	1.4666	26.10
4	M.S. Re-bar	50	1.43	0.0670	10.6000	0.63
5	Sand	25	33.34	0.0320	0.0333	49.00
6	Bricks	10	21.06	0.0110	0.8333	1.30
7	Fly-ash Based Bricks	40	22.35	0.0420	0.4000	9.50
8	Ceramic tiles	500	8.05	0.5180	0.8330	38.34
9	Marble / Granite	1200	39.23	1.5980	0.3000	84.19
10	PVC Sheet Plain / Corrugated	20	12.67	0.0380	23.3333	0.16
11	Aluminium Sheet Plain / Corrugated	150	0.58	0.2000	66.6667	0.30
12	A. C. Sheet Plain / Corrugated	20	3.38	0.0270	0.7000	3.71
13	G. I. Corrugated sheet	200	31.65	0.2670	12.6667	2.06
14	G. I. Pipe (100mm diameter)	200	5.60	0.2670	13.0000	2.01
15	A. C. Pipe (100mm diameter)	250	40.96	0.3330	0.8000	29.39
16	C. I. Soil / Rain Water pipe (100mm diameter)	900	30.58	1.1990	10.0000	10.71
17	P. V. C. Pipe (100mm diameter)	20	6.89	0.0630	24.0000	0.26

Reduce Pollution

- ◆ **Air Pollution**- Use of materials with low VOC emissions e.g. *Cement Paints*

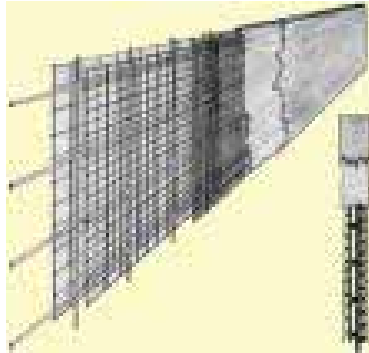


- ◆ **Water Pollution** – Materials that prevent leaching.



- ◆ **Land Pollution**- Materials that reuse waste that would otherwise have resulted in landfill. e.g. *Flyash Bricks*.

Performance



- ◆ Reduce material use
These are energy efficient and also help reduce the dead load of a building.
e.g. Ferrocement

- ◆ Durability & Life Span

Material that are exceptionally durable, or require low maintenance
e.g PVC pipes.



Energy Conservation

- ◆ Materials that require less energy during construction e.g. *precast slabs*.



- ◆ Materials that help reduce the cooling loads- e.g – *aerated concrete blocks*.

- ◆ Products that conserve energy – e. g. *CFL lamps*.



- ◆ Fixtures & equipments that help conserve water e.g. *Dual flush cisterns*

Recyclable

- ◆ Reuse or Recycle as different product e.g. *steel, aluminum.*



- ◆ Biodegradable – that decompose easily e.g. *wood or earthen materials.*



Evaluating Systems

International

- ◆ US EPA – Env preferable purchasing (EPP)
- ◆ Green Seal
- ◆ Greenspec products
- ◆ BEES (Buildings for Environmental and Economic Sustainability)
- ◆ JIS – Japanese Industrial Standards

Evaluating Systems

National

MOEF – Proposed certification of all eco-friendly products as ‘Ecomark’

CPCB is entrusted with the task of developing the standards for certification.

Evaluating Systems

Constraints

- ◆ To qualify any material as eco-friendly it is necessary to conduct a life cycle analysis of each material.
- ◆ Each study has to be on a product to product basis

Task 4 – Draft List of Eco-friendly Materials



Conventional Eco-friendly materials

1. Bamboo, Bamboo Based Particle Board & Ply Board, Bamboo Matting
2. Bricks sun dried
3. Precast cement concrete blocks, lintels, slab. Structural and non-structural modular elements
4. Calcined Phospho Gypsum Wall Panels
5. Calcium silicate boards and Tiles
6. Cellular Light Weight Concrete Blocks
7. Cement Paint
8. Clay roofing tiles
9. Water, polyurethane and acrylic based chemical admixtures for corrosion removal, rust prevention, water proofing
10. Epoxy Resin System, Flooring, sealants, adhesives and admixtures

Conventional Eco-friendly materials

11. Ferro-cement boards for door and window shutters
12. Ferro-cement Roofing Channels
13. Fly-ash Sand Lime Bricks and Paver Blocks
14. Gypsum Board, Tiles, Plaster, Blocks, gypsum plaster fibre jute/sisal and glass fibre composites
15. Laminated Wood Plastic Components
16. Marble Mosaic Tiles
17. MDF Boards and Mouldings
18. Micro Concrete Roofing Tiles
19. Partical Boards
20. Polymerised water proof compound

Conventional Eco-friendly materials

21. Polymerised water proof compound
22. Portland Pozzolana Cement Flyash / Calcined Clay Based
23. Portland Slag Cement
24. RCC Door Frames
25. Ready Mix Cement Concrete
26. Rubber Wood Finger Joint Board
27. Stone dust
28. Water proof compound, adhesive, Polymer, Powder

Potential Eco-friendly materials & techniques

1. Bagasse Board - *BMTPC*
2. Bricks from Coal Washery Rejects - *CBRI, Roorkee*
3. Building Blocks From Mine Waste - *SERC*
4. Burnt Clay FlyAsh Bricks - *CBRI, Roorkee*
5. Coir Cement Board - *CBRI, Roorkee*
6. Compressed Earth Blocks - *BMTPC*
7. EPS Composites and Door Shutters - *CBRI, Roorkee*
8. Fibre Flyash Cement Boards - *BMTPC*
9. Fibre Reinforced Concrete Precast Elements, Wall panels, Blocks, Manhole Covers - *SERC*
10. Fibrous Gypsum Plaster Boards - *CBRI, Roorkee*

Potential Eco-friendly materials & techniques

11. Flyash Cellular Concrete, Flyash Cement Brick, Blocks - *BMTPC*
12. Flyash Lime Cellular Concrete - *CBRI, Roorkee*
13. Flyash Lime Gypsum Brick - *BMTPC*
14. Insulating Bricks from Rice Husk Ash- *Central Glass and Ceramic Research Institute, Kolkata*
15. Jute Fibre Polyester -*BMTPC*
16. Non Erodable Mud Plaster - *CBRI, Roorkee*
17. Polytiles - *CBRI, Roorkee*
18. Timber from trees such as Poplar, Rubber, Eucalyptus - *BMTPC*
19. Precast walling roofing components - *CBRI, Roorkee*
20. Prefab Brick Panel System - *CBRI, Roorkee*

Future Tasks

- ◆ *To evaluate the eco-friendly properties of each of these materials*
- ◆ *Develop recommendation for Pune city Eco-housing criteria*
- ◆ *Evaluation of Financial impacts of using eco-friendly materials*



Thank you